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During the preliminary design of a low-current-level, ion - secondary-electron scintillation detector similar to that described by Daly[1] and Krebs et al[2], it was decided to investigate the internally generated noise pulse spectrum in the 6097S photomultiplier. Since the photomultiplier is to be used at room temperature, a cesium antinomide (SbCs) photocathode was selected in preference to a more sensitive SbCsO photocathode in order to improve the signal-to-noise ratio. Table I is a comparison of the specifications[3] of the two photocathodes at 25° C and was the basis of the selection of the 6097S.

TABLE I

Photo-cathode	Photo sensitivity, μamp/lumen	Quantum efficiency at 4200Å, percent	Dynode type	Dark Current at overall sensitivity of 2000 amp/lumen, mμamp
SbCs	50	14	SbCs	10
SbCsO	70	17	SbCs	50

The photomultiplier was operated with a grounded photocathode and was supplied by a voltage divider chain consisting of eleven 1-megohm resistors and one 2-megohm resistor between the photocathode and the first dynode. The signal that was developed across the 100-kilohm anode load resistor and the associated capacity was preamplified by a stacked cathode follower.

corresponds to $3.5 \pm 0.5 \times 10^{-14}$ coulombs on the input capacity. The error arises primarily from the inaccuracy in the photomultiplier gain.

The observed rate of 24,000 photoelectrons per minute (400/sec) compares favorably with that calculated from estimates of the thermionic emission density and the effective photocathode area[3]. The agreement was not expected since other investigators[4] have traced a large fraction of the photomultiplier noise at these charge levels to regions other than the actual photocathode. This effect of a large percentage of additional noise above that due to the actual photocathode seems to be predominant in photomultipliers whose photocathodes and dynodes are sensitized by the addition of oxygen. Since additional oxygen was not present in the SbCs photocathode and dynode structure of the 6097S, the agreement is not too unreasonable.

From the data presented in figure 1, the value of the mean secondary electron yield per incident ion, and the conversion efficiency of the scintillator, estimates can be made of the detection efficiency and limiting values of ion currents, which are measurable by the ion - secondary-electron scintillation technique.

It is also interesting to speculate as to the physical significance of the two population groups of electrons that may be interpreted as existing by the two linear portions of the data shown in figure 1. Whether these two regions reflect in some way the statistics involved in the secondary multiplication process at the first dynode is questionable at this time. If, however, the decay constant from the lower line is computed, a value of 3.6 electrons is obtained; this value is not too unreasonable for the

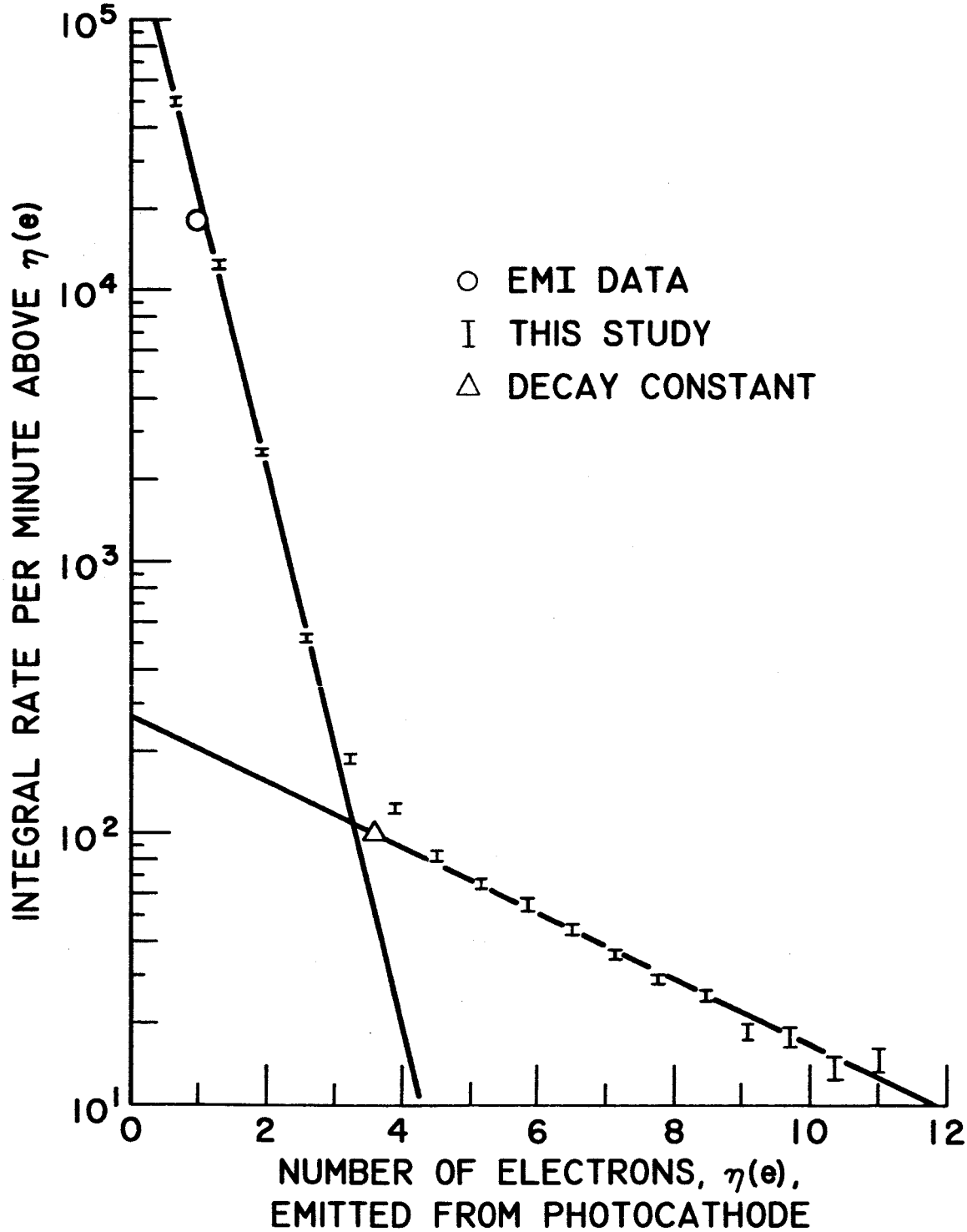

Figure 1. - Noise characteristic of the 6097S at 930 volts overall, after stabilization occurs. Room temperature, 23° C.